SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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The Royal School of Mines, Jermyn Street.

Mr. WARINGTON SMYTH'S LECTURES.

[FROM NOTES BY OUR OWN REPORTER.]

Lectures LV. and LVI.—Mr. Smyth, after some rehearsal of his previous remarks on ventilation, proceeded to speak of air-crossings, an arrangement which is frequently necessary in extensive collieries. There will invariably be some points at which one branch or division of the air must pass over another. Suppose we are dealing with lines of levels running east and west, along which is the principal intake, at some point a split is made, which passes off a portion of the air to ventilate a given district, but in order to do this it must cross the return air drift. In small collieries the returns are blocked off, and the air carried across in a kind of trough, but it is an unsatisfactory plan, as it is liable to damage, and taking up a large portion of the drift, and so prevent the passage of the air through it. In order to obviate these disadvantages, a crossing is made, for which purpose, on approaching the point of contact, the return air-way is made to rise up, and passes over generally by means of an arch constructed with strength enough to resist an explosion on a small scale. If there is reason to apprehend explosions, it is important that the crossing should be very strong indeed, and in such cases the arch is often carried into the solid rock overhead, leaving a large piece of ground between the two. When this is done the rise must commence at a greater distance, so that it may not be too abrupt. Up to the middle of the last century even the best of coal mines were worked on a most dangerous system, examples of which can now only be seen in extremely rare instances, where the adventure is a very small one. Even when better ideas became general, and two shafts became the rule—that is, upcast and downcast—there were large spaces, perhaps, in the very centre in which the ventilation was left dead, and in which there could hardly help being accumulations of carbonic acid gas or of fire-damp. The air was made to circulate round all the actual working faces, and to pass into the stalls, and a stranger going down and visiting these places would think the ventilation quite satisfactory. He would not find out that there was any deficiency until he got into the return air, which he would find exceedingly hot, close, and stifling, and, perhaps, highly charged with fire-damp. This system was first improved upon by an engineer named Spenning in 1760, who introduced a system called "coursing the air," by which no place in the mine was left unvisited by the air current. As collieries, however, became more extensive under the exigencies of modern requirements, this system was found to be inconvenient, and, in fact, defective. As the current had to go through more passages, it was requisite that it should have more force, the length of the levels being not unfrequently in large collieries as much as 30 or 40 miles, and going that distance, and passing through all kinds of places, the air became exceedingly noxious and dangerous. Indeed, in the latter part of its journey it would be not only unsafe, but utterly unfit for men to breathe. To meet this difficulty, Mr. Buddle, a famous colliery viewer of his day, proposed to split or divide the air into a number of districts, for which purpose it became necessary to divide the entire colliery into a series of panels. By this means the length of the air course in each case was greatly shortened. Thus, supposing the whole distance to be 40 miles, and the workings to be divided into four parts, none of the air would travel more than 10 miles, instead of 40, as under Spenning's system. No difficulty was found in doing this, for shafts are invariably larger in superficial area than the drifts. A shaft 10 ft. in diameter would have an area of 78·5 square feet, and the ordinary size of the larger drifts being 6 ft. wide by 5 ft. high, the area is 30 ft., or less than one-half the area of the shaft. There is, therefore, no reason why a shaft 10 ft. in diameter should not supply two sets of drifts. The adoption of this principle led to a most important alteration in all collieries. The way the principle is carried out needs but little illustration. The main current of air is divided near the bottom of the downcast shaft into two; then a little further on each division is again divided. Each current of air passes round the particular panel into which it is directed, and so back into one general return air-way. Sham doors may be put in to regulate the pressure by which the air is allowed to pass, and to join the main return, into which it is always necessary to be careful to allow no naked light to be brought. These are improvements by which alone it has become possible to deal with collieries of such large dimensions as are now common. In this way 100,000 cubic feet, and in some cases as much as 200,000 cubic feet, per minute are passed through each section, a quantity which, under ordinary circumstances, is enough to keep the workings clear of fire-damp; but, after all, we still remain incapable of dealing with exceptional cases, such as the sudden outburst of blowers and such like pent-up magazines of explosive gases.

Mr. Smyth next described the system in use and enforced by law in Belgium, denominated the "ascensional system." This was done simply by carrying the air first to the very lowest part of all the workings, and then conducting it upwards and out by the shortest shaft. This principle was not, however, yet generally admitted to be the best, and there were cases to which it was not at all applicable. Thus, in a certain colliery in Prussia, worked by English capital, the Government officials insisted on a drift being carried a considerable distance, and at a great expense, from the workings to the upcast shaft, whereas the English engineers who were consulted were unanimous in agreeing that under the circumstances all that expense might be saved, and the efficiency of the ventilation fully maintained, by carrying the return air downhill to the bottom of the upcast shaft. It was argued, and with much force, that making another entry into the upcast at a point level with the workings, so that the law requiring all the ventilation to be ascensional might be carried, did in this case cut off a portion of the column of heated air, and, therefore, lessened by so much the ventilating power of the shaft.

I have pointed out (continued the lecturer) the danger of bratticing shafts, and especially when the brattices are of wood, and how desirable it is to have the main doors of great strength, and stoppings of a permanent character between the two shafts, but in all the arrangements of collieries there is the danger in case of accident that the distance through which the air can travel will be materially shortened, leaving all the workings dead beyond the point of accident. It is usual in accidents for a much larger proportion of the workmen to be killed by the choke-damp which follows than by the explosion itself, and it is obvious that if some ready means of rescue could be provided, a large number of those who now become victims might escape. Various contrivances to effect this have been suggested, but they have all been found utterly inadequate. Of these the idea of carrying air by pipes into the workings has had the most favour amongst theorists, but the levels themselves are intended to act as pipes of gigantic size. It is simply impossible to get air enough through the largest pipes, but if it were, any such plan would be objectionable, because the pipes would be constantly in danger of fracture by falls of roof and other cognate contingencies. For many reasons, therefore, it is a recognised fact amongst mining engineers that no system of pipes could possibly be devised which would be capable of a satisfactory and practical adoption. Another suggestion is that refuge stalls should be constructed, to which a sufficient quantity of fresh air should be supplied, so that the men who were able to reach them would find a safe retreat until they could be rescued. No plan of this kind, however plausible in theory, could be carried into practice. The air would, in spite of all contrivances to detain it, be apt to make its way out of the refuge stall, and it would be impossible to exclude fire-damp. Besides which it would be most difficult to say in what place such refuges should be erected. Another suggestion is that every working place should be supplied with a separate intake and outtake, which theoretically sounds well, so that in case of explosion no one in the other places of work would suffer. This, however, would require so large an outlay as to render it impossible for it to be adopted, consistently with profit. There is, however, an approximation to this idea, which is now done in large collieries by their division into panels, and the sub-division of currents of air, which might be carried out to a much greater extent than it is. In the Northern Counties, where the winning of coal is very expensive owing to the great depths to which they are now obliged to sink, the sub-division of the workings into a number of small compartments with separate shafts is quite out of the question commercially. There is, in fact, no use in pointing out plans which cannot be made to pay, or are inconsistent with commercial success. The great point in all plans of working or ventilation is that, with the other advantages promised, they shall not be inconsistent with the payment of a certain amount of profit to the owners. This may be done with the panel system, and that system may also be applied to existing workings by putting in strong stoppings, and other like arrangements. The sub-divisional principle carries the air with unbroken force to each place of working, and carries back the impurities and gases it brings away with it at once to the upcast shaft, without taking these impurities into other workings. The result is that the air, as a rule, never becomes so foul and explosive; and if an explosion should occur the men might get into the other panels, and be saved from the choke-damp. Thus, in an explosion which took place at the Risca Black Vein Colliery some years ago the bodies of some of those who were killed were found several hundred yards from the spot at which the explosion occurred, and the poor fellows might have been saved had the workings been arranged on the panel principle.

I will mention a few of the leading facts which show us on what principle ventilation depends, because curious mistakes are sometimes made by persons who ought to know better. Thus, if we take a place in a mine where the air is rushing by we might say that there was a great amount of ventilation, but it may after all be caused merely by obstructions, and the velocity at that point would be too high to be consistent with good ventilation. The operation of natural laws are now thoroughly established. Thus, Mariotte has shown conclusively that the volume of a given weight of air is inversely proportioned to the weight of it, the pressure remaining unaltered. Another important law is that laid down by Gay Lussac, who proved that, the pressure remaining constant, the increase of volume imparted to the air by heat is uniform and equal for each degree of heat; and that for each degree Fahrenheit of warmth the volume of air is increased by one 459th of its volume at zero—so that, if the heat of the air be $t°$, it will increase the volume by $t \times \frac{1}{459}$. Applying these rules, it will be obvious—

1.—That the pressure to be overcome varies according to the length of the gallery, so that if it be so much in one mile of workings, it will in a second mile have twice as much resistance as in the first.

2.—The resistance varies according to the square of the velocity of the current. This is an important point, because it is often said that if the current will blow out a candle the ventilation is good; but this rules proves that while at one place the current may be 3 ft. per second, and at another 6 ft. per second, the difference does not arise from any increase in the quantity of air, but in the variation of resistance, the difference being in that case as that of 9 to 36, so that, increasing with this rapid ratio, there is an enormous loss of power.

3.—If the volume of air remains the same, the resistance varies inversely with the sectional area of the air-way, so that the larger the air-way the less resistance is offered, and the larger the volume of air obtained.

This shows that the air-ways ought to be made as large as possible, consistent with other circumstances, so that all idea of pipes is out of the question in dealing with large bodies of air. There is another point affecting the division of air—that in galleries of equal sections which differ only in length, but in which the one is more tortuous than the other, the velocity will be greatly interfered with, so that probably where in one place 33,000 cubic feet may pass per minute, only 20,000 will pass in more crooked parts of its course. In order, therefore, to secure a proper distribution through all the workings, all the circumstances must be carefully considered, and when falls of roof or anything else have happened to produce obstructions, they should be removed as quickly as possible.

A knowledge of these principles is not less important as affecting the ventilation of metalliferous mines, even where, as in the case of the Levant Mine, there is throughout the greater part of it admirable ventilation from natural causes. Towards the bottom of the mine they have from 80° to 90° of temperature, and in some of the levels, into which the ventilating current would not naturally flow, it is even higher, and then artificial contrivances have to be resorted to. In metalliferous mines these ventilating contrivances are not so constantly as they should be based upon the principles which guide spontaneous ventilation, and those which have been found most manageable and effective in dividing the currents of air.

There are many modes of estimating the velocity of the air. In metalliferous districts some of the men by long practice can tell by walking along the levels with a lighted candle how much air per minute is passing through, and that to a nicety quite sufficient for some ordinary purposes. It is, however, generally necessary to resort to more exact expedients. In making calculations of this kind the first point is to ascertain the area of any given level by measuring the height—say, 6 ft., by the breadth 5 ft., which would give an area of 30 ft. Then, having measured off a convenient length, say 200 ft., a little gunpowder is fired off, and then, by timing the movement of the cloud of smoke by a stop watch, the rate at which it moves per minute is obtained. Then, multiplying 200 ft. by 30 ft. area, you get the number of cubic feet of air which pass through that portion of the workings per minute. There are, however, many excellent instruments for measuring air currents. One of the best known, perhaps, is Biram's Anemometer, made by an instrument maker at Derby, named Davis. It consists of a fan-wheel, which is placed in the air-way with screw vanes. These are pitched at such an angle as to take the full force of the current. The axle of the fan-wheel being thus set in motion, certain indices are marked upon the side, showing tens, hundreds, and thousands. In order to get the velocity the engineer notes the position of the indicator, and then sees by its change of position what has passed through the instrument in a given time. By the constant use of this instrument a continual check is kept upon the efficiency of the ventilating furnaces. The same instrument is made on a smaller scale, the wheel being 6 in., 4 in., or even only 2½ in. in diameter, in which case, the friction being less, better results are obtained. The instrument of Prof. Phillips, of Oxford, made at the suggestion of Mr. Tickell, a colliery viewer of eminence, is a graduated quadrant, with a balanced vane, which rises or falls by the effect of the air, and thus indicates the speed of the current. Another delicate and beautiful little instrument, made by M. Casella, of Hatton-garden, shows the very slightest current. These instruments, placed at little distances apart, according to the amount of friction the air is exposed to, give results which, if not mathematically, are comparatively accurate. If they only represent to us the results upon the ventilating current produced by the changes of weather, and the variations of barometrical pressure, those results are so important that regular records of the measurements ought to be kept. Such records should be tabular, and show the reading of the barometer, of the thermometer, and the wind, the velocity of the intake, and that of the returns. The instrument most frequently used to reckon what is called the "drag" of the mine—that is, the tendency of the air to force its way through old door ways and stoppings—is the water gauge. There is, however, a very good instrument for this purpose, invented by Mr. Dalgleish, of the Seaham Collieries.

Before passing to the remaining branch of our course of lectures, I wish to add a few words, not so much affecting arrangements for measuring the quantity of air passed through a mine, as those which relate to ventilation generally. Nothing could be more useful to you in your future course as mining engineers or managers to carefully study the records of the principal accidents and catastrophes which have taken place in consequence of explosions of fire-damp, and trace them up to their source in all those cases in which the condition of the colliery has undergone careful examination, and where circumstances have permitted such a course, carefully discriminating between those which have been occasioned by the want of completeness or the insufficiency of the arrangements, or by sudden changes of weather. There are accidents innumerable arising from causes and circumstances, to meet which no provision is made, from the carelessness of workmen, from want of proper discipline, and from a disregard of regulations with regard to lights, even although the men know very well their safety and that of their fellows depend upon their strict observance.

No doubt such a task would involve the expenditure of a great deal of time, because such information would have to be sought in private as well as in public records. The whole of the series of reports published year by year by Her Majesty's Inspectors of Mines, from all the districts of Great Britain, might be studied with great profit; for where the source of an accident has ever been traced to certain causes, those causes ought never to occur again. No doubt the greater part of the accidents by explosion are caused by insufficient ventilation. The simple panacea, therefore, for all such evils would appear to be better ventilation, but every practical man knows it is impossible to convey currents of air through all the goaves, and that there are exceptionable cases, in which no possible quantity of air would prevent an accident when a sudden blower fills the mine with gas, should there be naked lights accessible to it. In addition to these, there is also a source of danger in some districts, which, probably, plays a much more important part in accidents than people are aware of, and that is spontaneous combustion. Certain kinds of coal are very much liable to this; the rubbish and slack if allowed to remain even for a very short time will begin to smoke, and after a time burst out into a flame. If in such a case the state of the atmosphere is explosive an accident may occur without the intervention of the workmen's lights. Where this danger is apprehended it is usual to have a quantity of well-tempered clay at hand, and so enable the men to construct a thin and air-tight wall. Indeed, in some particular methods of working, as in South Staffordshire, where the whole coal is won, the small, which is intended to be left below, would absorb very much oxygen from the atmosphere, and might take fire. The decomposition of pyrites, existing in minute grains, is by some thought to be the *vera causa* of many an accident of this sort. You may see in the cabinets upstairs many specimens exhibiting decomposition of pyrites, but whether the evolution of explosive gases is assisted by their presence is a question that requires further observation.

Another source of danger is to be found in the objectionable and somewhat anomalous plan of firing shots in fiery seams to bring the coal down, and there is no question but even when no explosion has taken place the coal has been lighted by this means, and has been found very difficult to put out, involving great loss of life, and in some cases overpowering all that could be done to extinguish the fire destroying the colliery. Where a coal is subject to this, care must be taken to prevent the fire from spreading, and a sufficiency of well-tempered clay should always be kept at hand, so as to be able to build a wall alongside the workings on fire, and so exclude all currents of air. In the undersea collieries at Whitehaven, where the coal is of this easily ignitable nature, and where the men, notwithstanding, use blasts of gunpowder, a very good plan is adopted. The workings extend in a straight line for a mile and a half under the sea. As they pass outwards they meet with certain faults. The coal dips down, and is then thrown up again by the faults, and a new district is opened out. These faults afford a good means of checking a fire if one should break out, and so door-frames are constructed in certain places in the solid rock, and stout dams are kept at each place ready to put in. If, then, any accident occurs from fire the dam is at once put in, and the supply of oxygen being thus completely cut off the fire is isolated, and after a time, when the place is re-opened, is usually found to have been smothered out. To ascertain how matters are going on a small pipe is left, so that by removing the stopper it is found whether the temperature of the air does or does not indicate the continued presence of fire. Accidents of this kind are not only due to the nature of the coal, but sometimes to the proximity of the ventilating furnace; and any want of promptitude in dealing with such cases is sure to lead to loss of life and property. If the place can be got out the burning material may be removed bodily away, and go out of the pit. The heat and smoke, however, often prevent this, and it not unfrequently happens that it is necessary to seal up the pit mouth. This is done by erecting a platform in the shaft, a few feet below the surface, and then filling it up to the top of the pit with soil. That, however, is an expedient which seldom proves satisfactory, as air somehow or other, in spite of every precaution, will get into the pit, in some cases through the measures themselves, and pits have been sealed up for years without the fire being extinguished. Occasionally water is allowed to flow into the place where the fire is, or the pumps are stopped and the water allowed to rise in the workings. If the seams lie flat a colliery manager will hesitate before he lets in the water, because when it is once admitted there is no telling what damage it may do, and how it will impair the safety of the roofs of the levels. Other dangers arise from these subterranean fires by the deleterious and often poisonous fumes produced, and the methods of dealing with all these classes of mining difficulties is one of the severest tests of the resources and ability of a mining engineer which is to be found in this most diversified and trying of all professions.

LEAD-BEARING DISTRICTS OF THE NORTH OF ENGLAND.

An interesting and highly instructive lecture on this subject was delivered by Prof. Morris, at the London University College, to the members of the Geologists' Association, on June 4, in which, after pointing out the situation of the district to be referred to, he succinctly described the character and external features of the surface and the general geological structure of the Northern Counties, carefully explaining the details of the changes and character of the carboniferous rocks from the south to the north; the division of the carboniferous limestone into two groups in the north, and the character of the country on the north and south of the Tyne—the lower or scar limestone, and the upper or Yoredale rocks, which hold all the lead ore. In a subsequent part of the lecture he treated of the igneous rocks, of faults and their direction, of the mining district, different kinds of veins and minerals, concluding with some general remarks on the mines, produce, and other particulars connected with the district. We subjoin a brief outline of the lecture.

The district to which attention is directed is situated in the centre of Great Britain, and the most elevated part, which is thickly inhabited by an industrial population, many of whom are occupied, or connected, with the working of the mines. The agent's house of the Beaumont Mines is at an elevation of 1400 feet above the sea, and Kilhope Law 2206, while Crossfell, capped by Millstone Grit, attains a height of 2901 feet, Dufton Pike 1575 feet, and the Cheviots 2676 feet, the three counties of Northumberland, Cumberland, and Durham meeting at Rampgill Head; Durham, Yorkshire, and Westmoreland at Cauldron Snout. This elevated district, bounded on the east by the Tyne and Wear coal field, and on the west by the Whitehaven field, chiefly consists of the carboniferous rocks, and presents varied physical features. The Penine chain, of which Crossfell is a part, extends from the borders of Scotland to Derbyshire, and being westerly forms the Watershed, and thus to the east side rise the waters of the Tyne, Wear, and the Tees. The country presents a varied aspect; to the east broad low plains, succeeded by rolling hills and dreary elevated moors, followed by a more hilly and more rugged district, rising gradually on the east side of the Penine chain, and descending more steeply on the western side. These, together with the character of the rocks, influence the vegetation of the country, as shown by the basset of the Great Limestone, which forms almost the boundary of cultivated land and human habitations. Above it, as Mr. Sopwith says, are, more or less, brown and dreary moors, and below it the hill sides present a green surface and flowery meadows. The counties of Northumberland and Durham occupy about 2905 square miles, three quarters of which belong to the carboniferous beds.

The geological structure consists of more or less altered aqueous rock with others of igneous origin, some anterior, some probably contemporaneous, and others posterior to the stratified rocks. The aqueous include the Silurian, Devonian, Carboniferous, Permian, Triassic. The igneous are porphyry, basalt, or Dolerite. The Silurian consists of schists, grits, and slates, altered and much plicated or folded, containing very few fossils, except graptolites; it attains an elevation of 1700 ft. The Old Red attains an elevation of 200 to 700 ft., and is about 500 ft. thick, with a few fishes (Holoptychius, &c.); it is unconformable to the beds below, and conformable to the carboniferous, of which it forms the base. This unconformity is well seen at Siccar Point, near St. Abbs Head, Berwicks; also at other places on the way to Canrobie. The carboniferous rocks, which are about 7000 ft. thick, and occupy three-quarters of the area, include the Tuedian, Scar and Yoredale series, millstone grit, and coal beds. The Tuedian consists of sandstones, shales, and limestones, sometimes magnesian, but no coal; it is about 1000 ft. thick, with indications of estuarine conditions; it contains remains of plants, shells, cephalopods, some fish, but no crinoids or brachiopods.

With regard to the carboniferous limestone, great differences are observed in tracing this deposit from south to north. It is very uniform in the South of England, North and South Wales, and in Derbyshire. It is wanting in South Stafford, where the coal measures overlie the Silurian rocks, but in Yorkshire a change takes place. A line drawn from Jervaux, in the Yoredale, Yorkshire, through Kettlewell and Malham, to Lancaster, separates, according to Phillips, the southern type, in which the lower limestone group is nearly undivided, and the upper limestone group thin, and with interbedded shales. In the northern type the lower limestone group is divided by shales, sandstones, &c.; and the upper limestone group, about 1000 ft. thick, is complicated, and consists of limestone, coal, flagstone, and shales, alternating with each other. In the more northern counties a still greater complexity is observed, as in Northumberland, Durham, and

Cumberland, showing a transition to the Scottish type. Thus north of the Tyne and the great 90 fathom dyke the carboniferous limestone is divided by Mr. Tate into two series—the lower carbonaceous, the upper calcareous, the total thickness being about 2600 ft., of which 1400 are sandstone, 900 shale, 230 limestone, 70 coal; the lower, about 900 ft., extends from the Tuedian to the Dun limestone, contains but little limestone (about 20 ft.), but eight seams of good workable coal, of which Scremerston and Cooper Eye coal are the best. The upper series, 1700 feet thick, is distinguished by its workable limestone (about 200 ft. thick), interstratified with sandstone, shale, and coal, some of fair quality, as the Shilbottle and Licker coals, and the Beadnell about 5 ft. thick, but others poor and thin. South of the Stublick dyke the whole series, according to Forster's section, has a thickness of 2080 ft., of which 820 are siliceous, 790 argillaceous, and 470 calcareous. The series has been divided into two groups, the lower, below the Whin sill, comprises the scar limestone series of Phillips, crop out in Cumberland and Westmoreland, and include the Melmerby limestone. The upper, comprising the Yoredale series, include the strata between the Whin sill and the Fell Top limestone, of which the larger portion consists of argillaceous and siliceous sediments, with about 180 ft. of calcareous strata, and 4 ft. only of coal.

Table of the Relative Thickness of the Lead Measures (Yoredale series, Phillips) from the Fell Top Limestone to the Tyne Bottom Limestone above the Whin Sill, showing the principle Mineral Characters and their Alternation, and the predominance of mechanically formed over chemical and organic formed Strata, from W. Forster's "Section of the Strata," p. 165, *et seq.*:—

ARGILLACEOUS AND ARENACEOUS.		CALCAREOUS.	
		Fell Top Limestone .....Feet	4½
Crow Coal, Hazle, Plate, Slate Sill, Firestone, Pattinson's Sill..Feet	330		
		Little Limestone.....	3
Plate and impure Coal	68		
		Tumbler Bed and Great Limestone, with three flat veins....	63
Tuft, Hazle, and Plate Beds	102		
		Four-fathom Limestone	24
Hazle and Plate	54		
		Three-yards Limestone	9
Hazle and Plate	46		
		Five-yards Limestone	6
Coal, Plate, and Hazle	30		
		Scar Limestone	30
Hazle, Plate, and Coal	37		
		Cockle-shell Limestone	2
Hazle and Plate	102		
		Tyne Bottom Limestone	24
Whetstone Bed, &c.....	3		
	Whin Sill.		

Referring to the igneous rocks, he commenced with the Whin Sill, so called from its sometimes being apparently parallel to the other strata, but really varies as much as 1000 feet when traced over the whole area; it is from a few to 200 feet thick, as in Teesdale, giving a picturesque character to the scenery, and may be traced through Northumberland, into Durham, Cumberland, and Yorkshire. It is anterior to the fissures holding the lead, as they traverse it, and also to the Penine fault, which may be contemporaneous with the veins, the force producing the one causing the other. The whin is a dolerite of augite and felspar, with titano-ferrite. Many dykes also traverse this district. Two are comparatively well known—the Hett dyke traverses the mountain limestone, millstone grit, and coal measures, and the Cockfield dyke, about 70 miles in length, passing through the mountain limestone, millstone grit, and coal measures, and new red sandstone. This district is traversed by many faults, which have had a most important influence on the physical character of the district, and to some extent upon the industrial resources. The 90 fm. dyke (east and west), Tynedale fault, and Stublick dyke, throw down the coal to the north and west—hence the Stublick, Midgeholm, Conewood, and Hartley Burn coal fields. The Penine fault has a downthrow to the west of 3000 feet, which, with the Craven fault, so materially influences the physical features of the district traversed by them. The Burtreeford dyke is a north and south fault, crossing the lead mine district from the Vale of Tyne to the Tees, affecting the Yoredale rocks only, and has an upthrow to the west. The Butterknowle dyke runs east and west in the county of Durham, and throws the strata down to the south. The Tees Valley fault is an upthrow of about 45 fathoms to the west.

The mining country occupies about 400 square miles, and includes the district of the head waters of the Tyne, Wear, and the Tees; the chief lead district comprising Derwent, East and West Allendale, in Northumberland; Weardale and Teesdale, in Durham; and Alston Moor, in Cumberland. The geological formation is the Yoredale series, or mountain limestone of Phillips, while the *lead* measures further west in Cumberland are found in the Silurian and metamorphosed rocks, each district having a somewhat distinct association of minerals. Discussing the question, What is a vein? Prof. Morris remarked that the rich or right running veins run a little north of east and south of west, the cross-veins bear nearly north and south, besides which are quarter point veins bearing between the two. When these veins lie near each other the two outer veins are termed north and sun veins respectively. The same vein has frequently many names, according to the lease length, which is about 1200 yards. Cross veins commonly alter right veins, but not always (as at Scaleburn cross vein), and right veins are often split, and sometimes lost in cross veins. The hade is the inclination, the upper side is the "hanger," and the under side the "ledger cheek." In Weardale the hade is south, in Allendale and Alston to the north but it varies with the nature of the strata. The throw of veins is a more or less vertical disruption of strata, but this is variable. There is, however, a connection as well known to practical men between the hade and throw of veins—if the throw is up to the south, the hade is to the north and contrariwise. Veins are different kinds, as rake, pipe, strings, gash, flat veins. The rake is the most common, and occupies a fissure extending downwards a considerable distance, and may have opposite, similar, or dissimilar cheeks, and thus the vein is more or less productive, and is irregular in size. The subjoined shows the character of the lode according to the nature of the cheeks:—

Argillaceous	Vein unproductive	Argillaceous.
Gritstone	Vein irregular	Grit or limestone.
Argillaceous	Vein poor	Grit or limestone.
Limestone	Vein favourable	Limestone.

A gash vein is a fissure which contracts downwards. The hade or inclination is mostly in the softer beds, and when two veins meet they are generally enriched. Regular veins have a slight throw, and the size of veins depends on the nature of the rock, being generally wider in limestone. A rider is the stony mass found in the vein, and divides it. A pipe is an irregular cavern, extending downwards, and is more or less tubular. A flat vein is a dilated vein in a space between two strata of stone, and resembles a coal seam, and inclines with the strata. With regard to the difference of produce in the various strata, the great limestone, at least in the Alston district, seems to be the most productive, although in other localities other strata are also productive. Mr. Forster mentions that the mines on each side of the Burtreeford dyke, being softer on the east side, and harder on the west, where they contain more blende, and rider. The chief minerals yielding lead are galena or sulphide, cerussite or carbonate, and oxide of lead. The associated minerals are blende, calamine, fluor, barytes, quartz, calc- and pearl-spar. It is said the cubical galena yields a purer lead than the wavy galena, which contains antimony. In the Cumberland district the phosphates and arseniates, with cerussite, linarite, and caledonite, or the coloured ores, are the chief lead ores, as at Roughtengill and Drygill.

Composition and character of the principal minerals from the districts above mentioned:—

			Hardness.	Gravity.
Galena	Sulphide of lead	Cubical	2·5 to 2·7	7·5
Cerussite	Carbonate of lead.....	Rhombic	3 to 3·5	6·4
Minium.....	Oxide of lead	Pulverulent....	2 to 3	4·6
Blende	Sulphide of zinc	Cubical	3·5 to 4	3·9 to 4
Smithsonite...	Carbonate of zinc.....	Rhombohedral..	4	4 to 4·4
Fluor-spar ..	Fluoride of calcium....	Cubical	4	3·1
Heavy spar ..	Sulphate of baryta	Rhombic	2·5 to 3·5	4·5
Witherite....	Carbonate of baryta ..	Rhombic	3 to 3·7	4·3
Bromlite	ditto and lime..	Rhombic	4 to 4·5	3·7
Barytocalcite.	ditto and lime..	Monoclinic	4	3·6
Pearl spar ..	Carb.of lime & magnesia	Rhombohedral..	3·5 to 4	2·8
Pyromorphite	Phosphate of lead.....	Hexagonal	3·5 to 4	6·5 to 7
Mimetite ..} Kampylite..}	Arsenio-phosphate,with chloride of lead .....}	Hexagonal	3·5	7
Linarite	Cupreous sulph. of lead	Monoclinic	2·5	5·4
Caledonite ..	ditto with carbonate	Rhombic	2·5 to 3	6·4
Brochantite..	Hyd. sulphate of copper	Rhombic	3·5 to 4	3·7

With a view to show the vast importance of the lead mines of the northern district, Prof. Morris mentioned that the number of mines and the amount of lead ore and silver raised in the following counties in 1867 was—

Counties.	Mines.	Lead ore.	Silver.
Northumberland and Durham ..	47	Tons 22,574	Ozs. 77,678
Westmoreland	7	2,418	25,142
Cumberland	75	5,682	31,022
Yorkshire	65	7,539	3,000

Whilst the total produce of Great Britain for 1867 was—Lead ore, 93,432 tons, of the value of 1,158,066*l.*; lead, 68,440 tons, worth 1,337,509*l.*; silver, 805,394 ozs., worth 215,400*l.*: showing that Northumberland and Durham raise nearly one-quarter of the total produce of the entire kingdom.

In conclusion, Prof. Morris acknowledged his obligations to Mr. T. Sopwith, F.R.S., and Mr. R. W. Bainbridge, of Middleton, and he noticed the general intelligence and civility of the miners, their willingness to impart practical knowledge, and further alluded to the well-sustained care which had obviously been bestowed by the large proprietors for the education and elevation of the people, and the promotion of their domestic comforts and happiness—a boon fully appreciated by them, and thus there did not appear to exist those unhappy differences between the employers and employed which in too many places are detrimental to the interests and welfare of every party.

GEOLOGICAL EXCURSION TO GUILDFORD.—Reference has already been made in the *Mining Journal* to Prof. MORRIS'S practice of supplementing his college lectures by practical demonstrations in the field, accompanying his students for this purpose in excursions to various parts of the country, where features of more than ordinary geological interest can be profitably studied. One of these excursions was made on June 2 (kept by a loyal public as Her Majesty's birthday), when some of Prof. Morris's class from London University College and their friends joined several of the members of the Geologists' Association (of which the Professor is President) in an excursion into Surrey, to examine the geology and other natural features of the beautiful neighbourhood of Guildford. The excursion was under the superintendence of Prof. Morris, who availed himself of the very valuable co-operation and guidance of Mr. C. J. A. Meyer, formerly resident at Godalming, and long interested in the district, and whose published memoirs have largely assisted in elucidating its geology. At Guildford the party was met by Prof. Rupert Jones, from the Royal Military College, Sandhurst, accompanied by several friends and officers of the Royal Staff College. The chief object in view in this excursion was the examination of the several kinds of strata forming the hills and vales in the vicinity of Guildford, Shalford, and Chilworth, especially as to the relative positions of the several beds of chalk, clay, and sandstone, which, lying either horizontal or in more or less inclined positions (in some places turned up almost on end), come to the surface in succession, and form flat, raised, or hollow ground, according to their power of resisting the wear and tear of frost, rain, rivers, and other denuding agencies that have worked over the land during the countless ages looked back into by geologists. Prof. Morris occupied the attention of the party in one of the picturesque green lanes near Shalford, by explaining the origin of the sandy soil they stood on, and the clay-beds to which the slope of the road was leading; how the sandstone, now turned up and exposed, was once horizontally laid down in the shallows of a wide sea, reaching from the raised land of the West of England far away into what is now Europe, and there deep, and richer in marine life, the waters deposited calcareous layers, now constituting the Neocomian formation of Neuchatel, represented in Surrey by a thin continuation, recognised as the Perna bed, as originally observed and explained by Mr. Godwin-Austen, of Chilworth, more than twenty years ago. Sands and mud filled up those primeval waters, and the results are the Lower Greensand beds, with their iron sandstones, white glass-sand (Reigate and Aylesford), Fuller's-earth beds (Nutfield), and Kentish Rag, where the oysters and other shells abounded more fully than elsewhere. Mr. Meyer pointed out in the Shalford sands the few isolated shells representing the thick oyster-beds of the Kentish Rag, and indicated the exact horizon in the Surrey lane-cutting, where fossil lobsters are abundantly found in the so called "Cracker-beds" of the Lower Greensand of the Isle of Wight. The very source of the pebbles and rolled bits of older fossils in these old sands of Surrey was indicated by the learned leaders to the enthusiastic students, the Oolite beds of Mid-England were credited with the bits of rolled ammonites, and the older Sandstones and Palæozoic rocks had to account for the quartz-pebbles and lydite fragments forming the grits and pebble-beds seen in the section of the Lower Greensand, as the party walked up from the ford at East Shalford to the crest of Chilworth Hill, examining the many layers of the uplifted and denuded Lower Greensand that gives rise to the picturesque escarpment. On Chilworth Hill the party assembled among the rustic groves under the tower of St. Martha's Church, and there, backed by the North Downs, and looking out over the broad extent of undulating country at the distant South Downs, they listened to Prof. Rupert Jones explaining how the succession of hill and vale coincides with the harder and softer strata, of chalk, clays, and sandstones, brought up by grand but gentle curves, in orderly arrangement, around a long elliptic dome, reaching from Alton on the west to Hastings, and beyond the Straits to France, and worn down, by natural agencies, of long continuance, from a high, broad ridge to the present comparatively low series of lesser ridges, and drained by rivers, following the radiating cracks of the raised ellipse, which have still kept their outward course through sandrock and chalk downs, deepening the widened rifts until the Pluvial period was over-passed, and now meander slowly among the gravel-beds and alluvial flats, till they reach the Thames on one side, and the Channel on the other. On their way to Guildford the geologists visited, near Titlings, a pit of chalk marl (used for plaster-lime, where the beds, upturned at an angle of 80°, afford a key to the general configuration of the country, as they show by local intensity the bending force to which all the strata have submitted. After some refreshment at Guildford, Mr. Meyer led the party to a quarry of the Lower Greensand west of Guildford, where the upper member of this interesting formation is well seen, with its oblique bedding and numerous regular faultings, and where its fragmentary shells, corals, and other organisms can be largely collected. A hasty visit to St. Catherine's Chapel, on the knoll of Lower Greensand, overlooking the railway, the valley, and Shalford Park, ended the expedition, which, favoured throughout with glorious sunshine, now broke up, amidst congratulations on a successful day and a happy meeting of mutual pleasure and instruction, with a hearty desire to meet again in that beautiful county under the guidance of the same good leaders.

THE WORKING AND VENTILATION OF COAL MINES.

Mr. J. WARBURTON read a paper at the Manchester Geological Society, on Tuesday, on the working and ventilation of coal mines. In the course of his remarks he said that the long-continued depression in the coal trade had forced upon all producers the necessity of economy in order to get a market at all, even sometimes at unremunerative prices. So much had this been the case during the last two years, that he believed a good many capitalists were diverting their money in other directions. Very nearly three years ago he had the honour of reading before this society a paper on what seemed to him to be the best methods to produce coal in a marketable condition, in which he confined himself to the method of getting coal. In this paper he proposed filling in the details as respected the whole of coal production, taking into account ventilation, transit, and all the concomitants of coal producing. He would only say of sinking that he never yet met with a shaft too large, but he had seen many too small. One other important point he had seen frequently overlooked—namely, the accommodation at the bottom of the shaft. Where a shaft is expected to have drawn through it from 500 to 1000 tons per day, and must work uninterruptedly eight, nine, or ten hours, a good deal of convenient storage room was required at the bottom. He had seen several important collieries seriously crippled at this point; yet going on without this heavy drawback to their efficiency being recognised. After some remarks on underground haulage, in which he expressed a preference for the use of endless chains, he continued: But there are many collieries where no kind of steam power is applied, but all the haulage done by manual and animal labour. In some of these collieries the haulage expense is very high indeed. It cannot be otherwise where men and boys alone are employed to do this kind of work, and in several places of medium pretensions no other power is employed. I have heard it used as an argument against the introduction of ponies even, that certain seams were too thin to admit them, and with some people this is a fatal objection. With regard to the employment of ponies, small ones are generally secured for collieries, and sought by owners for that purpose. It appears to me that policy is fallacious. If a seam has to be worked, and will pay to get the coal out by small tubs and low roads, will it not pay much better to make high roads and use large tubs? I should say most decidedly it will. So, with regard to ponies, it is much more economical to have one that can draw 16 tubs instead of one that can only take eight at one time. One lad can do for the former, and less than a lad cannot be employed with the latter. In any case, I would say, let there be large roads, and where animal power is used, large horses, and, in all cases, large tubs. For such is the perversity of underlookers and deputies, that however large or however small the ponies and tubs, you will be sure to find many roads just sufficient for the tub to go, and no more. No man or animal can exert his strength in a small space.

A word or two on tubs, corves, or trains. In various parts of the country, there are different kinds and shapes of tubs, some in keeping with the principle of their work, others made regardless of the nature of what they are to do. In South Wales, the Midland Counties, and some places in the North of England, they have wagons much more in keeping with the principle of their work. In Lancashire and Yorkshire we seem to make them as nearly square as we can get them, as if they had to travel sideways as well as endways, thus giving ourselves a broad end for resistance against friction, instead of having the same resistance only for a wagon some 18 in. to 2 feet longer. The resistance is not the only drawback. When made nearly square the tubs are much more liable to get off the rails, and more easily tipped over on the roads if the wheels or axles come in contact with any obstruction. The position of the wheels to each other is also a matter of more importance than is generally supposed. At two separate collieries where I advised an alteration of this kind, the objection raised by both the surface manager and underground steward or underlooker in both places was the same,—by the surface men, that the corves would not twist round so easily if the wheels were further apart; by the underground men (*i.e.*, underlookers), that the corves would not lift on the rails so easily when off. These details, to such a society as this, may appear trifles; but it is these trifles in the working of a colliery that go to make up the economy or otherwise. I will give a single instance of the importance of these seeming trifles. I am acquainted with a place where, at one of the pits, up to the end of 1865, they had never been able to draw more than an average of 1800 tons per week; but by attention to details such as are named in this paper, a weekly average of 3500 tons were being drawn with ease at the end of 1866. Economy can never be attained with low, bad roads, badly made tubs or wagons, the transit done by manual labour, or even small ponies. I have for some time seen that a great amount of risk and danger is incurred by a too free use of prop wood near the face coal. The true use of prop wood is very little understood. If props at or near working faces are used for anything but temporary purposes, they are expected to do what they cannot do. The sooner, after the coal is taken away, we can let the roof fall the better it is in every respect, both for safety and keeping the next length in better condition. Sprags to keep up the coal till properly holed, and props sufficient to form one or two rows lineable with the working face, are much better than a large quantity set here and there, or anywhere.

The getting of coal in its most marketable condition should not be sacrificed at the expense of getting the quantity cheap. Economy should be aimed at with this standard in view—that a certain fixed percentage must be in the most valuable condition. This should be the first consideration, and how to do it requires a good deal of skill and judgment. Few will dispute that the largeness of the coal is one of the conditions that constitute value. Also that this largeness should stand transhipping and conveying to its destination with as little depreciation as possible. There is a common expression among coal carriers and colliers in Lancashire that a "square dog-headed coal" is the best for standing knocking about—the expression meaning somewhat of a rhomboid shape, and being intended to convey a distinction between that and the thin laminated coal so easily broken during transit. As a rule, we might say that to get coal as described requires that the coal should be worked at right angles to the cleavage, be holed well and deep, and, if possible, got down by its own gravity, instead of shaking it to death by blasting. Having decided to get the coal in the best manner possible for the market, the next thing is to get it as economically as possible. In my opinion the fixed prices and the mode of fixing them appear to be erroneous. I have known the mode for a quarter of a century, and the same scale obtains now as did then, though labour, appliances, and all else have altered very much during that time. In Lancashire, as a rule, a coal-getter is everything almost connected with getting, and frequently performs the whole process of preparing—or holing and cutting—the coal, getting it down by hammer and wedge, or blasting, as the case may be, breaking it out, filling it, and even taking it to the shaft or portway. There seems to me to require a much wider division of labour. The man who does all may be efficient in all, but he can scarcely be expert in any one of the duties. Amongst our economy we ought to economise the labour of the coal-getters. There are many men old and disabled at 34 years of age through working in strait work. To work economically, in my opinion, would be to work with all the face open, and have neither strait work nor fast boys. I would have the face open all round if need be, and dispense with any cutting whatever. Work at right angles to the line of cleavage. Divide the work; one set of men having to do nothing but holing, another loading or filling, the responsible man having to take down the coal, set the props, draw the back ones, and see to the safety of the place; another set of men to take the roof down in the wagon road, and do the packing at the road sides; and bring a horse to a shunt kept close up to each working place. The first operation after the place is ready is to prepare the coal by holing, which is a very important matter. In Lancashire this holing is done generally at the bottom of the seam, in the coal itself; and, as holing has never formed a separate division or branch, it is done very imperfectly. The colliers of this county are not brought up to deep holing, and what is done has to be done at a great sacrifice of coal, as they "snape" the coal so much to get under at all. If they go three quarters of a yard, the front of the holing must have an opening of from 18 in. to 2 ft. The amount of coal I have seen cut away in this manner is incredible. It is this kind of holing that necessitates the use of so very much powder to get the coal down. When the coal is opened out in long faces, or long wall proper, there is very little difficulty in finding some thin bed of dirt about the bottom to hole in. Even if it were 18 in. thick I would hole in it, and have the whole got up and cast behind the men into the gob, and leave the coal intact. If well spragged and holed 4½ ft. 5 ft. or 6 ft. under, and backed up at the far end of the holing, the whole may be got down in large coal, and, as a rule, without powder, as its own weight will bring it down. Blasting in coal getting is a very unprofitable expedient, apart from the risk that attends it both to men and owners. Where a great deal of powder is used the value of the coal is very much depreciated thereby. Therefore, it cannot be economical to blast coal. Of course, there are exceptions, but they would be rare. It is a well-known fact that the least capable men in any colliery use the most powder, and as a consequence produce less valuable coal. Not the least part of economy in getting coal is to get it clean out—that is, leave none in the pit. It has always seemed to me a reflection on the mining faculty that in computing the amount of coal in a seam it is usual to strike off something like one-fifth of the whole as likely to be lost in pillars or other waste. In seams of ordinary and usual thickness, I see no reason whatever that the whole coal should not be taken abreast of the colliers, clean outright before them. Where pillars are left, to be gotten some other time, they are crushed and broken into slack, and very rarely indeed got out; and pillar getting is always attended with very great danger to the men.

I must conclude with a few remarks on the all-important question of ventilation. To ventilate economically means to ventilate efficiently. It is well known to those who have thought on the subject that for a colliery to explode there must be a deficiency of good air, there must, too, be much light carburetted gas, and in this condition the mixture must come in contact with flame or fire, and the more this fact is pressed upon those having charge of collieries the better will it be for all. If we were all taught, and thoroughly believed, that collieries could be properly ventilated I am convinced we should have fewer large explosions; but so long as we can persuade ourselves and the public that an accidental mis-shot can fire a whole pit, so long are we liable to these dire misfortunes. I do not say that a shot cannot fire a pit; but I do say, except there already exists the elements of combustion to very nearly an inflammable point, a shot cannot fire a pit. I am perfectly free to acknowledge that a mis-shot may do a great deal of harm in a confined place, such as the straight work commonly driven in Lancashire, but it seems very unsatisfactory not to be able to account for it. As many serious explosions have occurred simultaneously with the explosion of a heavy or mis-shot, there is a connection, if we could satisfy ourselves what that is. I have given it some thought, and strongly incline to the following idea:—That a mixture of gases just below exploding percentage would become explosive when suddenly compressed. Such compression, I believe, a fast shot capable of producing, and bringing that gas to an explosive point which previous to this sudden compression was not so. This, I think, would take place in the immediate vicinity of such shot, and the fire that caused the sudden com-

pression would ignite the gas around it, this ignited gas taking up the character of compressing and igniting till the whole air, with only one-thirtieth of carburretted hydrogen even was consumed, thus causing a general conflagration in a colliery where the fireman would say, with truth, that he could have taken his lamp top off without fear of an explosion. This could take place only in a colliery very imperfectly ventilated. It is matter of surprise to me that, with the present state of mining knowledge, collieries are to be found with a great amount of capital at stake so badly ventilated; indeed, there are places now working, and ventilating on such systems, that must sooner or later result in an explosion. It is now more than seven years since I suggested for colliery owners such an association for their mutual benefit as the Association for the Prevention of Steam-Boiler Explosions, and I still think it would be of immense advantage. A proprietor would get to know when his colliery was in danger, which is not always the case now. Working on the end of the coal has a special advantage as regards the ventilation. Cutting across the coal is like opening the ends of hundreds of small tubes, and thereby letting out the gas. This is one very great advantage I claim for working coal on end. By such a system we are much less liable to sudden outbursts, as the tubes are always open and drinking the gas from the body of coal. I have prepared a plan by which the cold wind goes direct to the working face, no doors or bratticing in the way; it has no circuitous air-courses to go up and down; it is upon the work at once; and it passes some 150 yards of the face of the working coal, having no other course than that, then retires into a return. There is something special about these returns, as they are all made through the waste, or are made like the other gates or pack roads as we proceed; but there are certain cross roads communicating with the returns from the goaves. These are kept open as indicators, for I find at these places the barometric pressure is less than elsewhere else in the pit, and if there is gas in the goaves, sooner than come down on the men at the face it will come at these places, and, being nearer the upcast, drain off, and never come near the men at all. The Oaks was long wall, and on end; but their lowest point of pressure was at the face where the men were working, consequently when the barometer fell the gas came upon the men from the goaves —and, in fact, that was its only outlet. This kind of ventilation is very objectionable. The system also of leaving the goaves behind is open to the same objection, as the lowest point of pressure is where the men are working.

PREVENTION OF COLLIERY EXPLOSIONS.

BLASTING WITH GUNPOWDER SUPERSEDED.

In referring to the recent Conversazione at the Institution of Civil Engineers, we remarked that the model of the machine by Mr. SAMUEL PARKER BIDDER, jun., of Mitcham, Surrey, for breaking down coal without the use of gunpowder, was probably entitled to the most prominent notice amongst the articles exhibited, and we are now enabled to give some further particulars concerning the invention.

The principal machine consists of a small hydraulic press, weighing about 60 lbs., and of 15 tons power. To this press is attached a pair of steel tension straps, bent in the form of a tuning-fork, and which are connected with the press by a collar. At the end of these straps is first placed a clearance box, about 4 in. long, and upon each side of the straps expanding pieces (also made of steel), which exert a pressure at the sides of the hole, and are 15 in. long. The points of a pair of twin wedges, 15 in. by 3 in., constituting one wedge, are then inserted in the expanding piece, and the machine is fixed in the hole. The hydraulic press (having been already charged with about three pints of water, which may be used over and over again without loss), is then worked by a man by means of a small handle, and the ram from the cylinder is forced out, thus driving up the pair of wedges between the expanding pieces, giving a lateral extension of about 3 inches. This not being in all cases sufficient to bring down the coal, the press is withdrawn, and the relief-valve opened, thereby allowing the water to return to the reservoir. A second wedge is then inserted between the two twin wedges by means of a small rod, ⅝-in. in diameter, and, the press being again connected, this wedge is driven home in the manner before described. By this means an additional expansion of 3 in. is obtained, making a total expansion of 6 in., which in most cases is found sufficient; but a third wedge can be applied, if necessary, and the expansion thus increased to any reasonable extent. In this manner as much as 10 or 12 cwts. of coal have been brought down in 10 minutes.

The drilling apparatus, the principal part of the machine, consists of a screw 4 ft. by 1½ in. diameter, to the end of which is attached the drill. The fulcrum for taking the resistance of the screw is obtained by inserting a bar of iron in the coal at the side of the place selected for the hole which the machine has to drill. This small aperture is made by punching with the ordinary instrument a hole 10 in. deep and 1 in. in diameter, and the time occupied in making this preparation is usually about four minutes. The small bar for taking the resistance of the screw is then inserted, and it may either be fixed at the side or in the face of the coal, as the case may require. The screw is then adjusted to this bar, and the drill driven in the coal by a man turning the handle at the end of the screw. The time occupied in drilling this hole for the machine, 3 in. in diameter and 3 ft. 6 in. deep, is from 10 to 15 minutes, according to the hardness of the strata; and if it is necessary to drill the hole in such a position that the rotary motion of the handle by which the screw is propelled cannot be obtained, a ratchet may be used, so that, under any circumstances, no difficulty can be felt in procuring the required motion.

The first trial of the machine was made at a pit belonging to the North Staffordshire Coal and Iron Company (Limited), at Talke-o'-th'-Hill, in a heading in what is called the Eight-feet Banbury seam of coal, at a depth of 350 yards from the surface, and under ordinary working circumstances, so far as the place selected was concerned. The following scientific gentlemen were present to witness the experiment:—Messrs. Peter Higson, Government Inspector of Mines for the district of South-West Lancashire and North Wales; Thomas Wynne, Government Inspector of Mines for the district of North Staffordshire and Cheshire; J. Higson, jun.,; William Rigby, of the Bunkers Hill and Audley Collieries; Josiah Evans, of the Haydock Colliery, Wigan; William Evans, manager of the New British Iron Company's Works, near Ruabon; Mr. Darlington, of the same colliery; Mr. E. R. Walker, manager of the North Staffordshire Coal and Iron Company's Works; Mr. W. Y. Craig, manager of the Lawton and Harecastle and Haumer Collieries, and consulting mining engineer; Mr. John Craig, jun.; Mr. Thomas Nicholls, ground bailiff of the Talk-o'-th'-Hill Colliery; Mr. William Oswald, ground bailiff of the Lawton and Harecastle Colliery; and Mr. T. Sherratt, an amateur.

Considerable difficulty is always found in fairly testing a machine under such circumstances as these, but, notwithstanding every disadvantage, the hole for the machine was drilled and about 4 tons of coal brought down in 25 minutes. Mr. Higson asked a workman in charge of the place how long it would have taken him to have drilled the hole and fired the shot according to the present system of blasting, and he considered that an hour would be required for the purpose, and a pound of gunpowder used at a cost of 5d. The superiority of the machine was, therefore, evidenced by the saving of 35 minutes in time and 5d., the cost of powder, and the work was done without the smallest danger to anyone. Two further trials of the machine were made in other parts of the workings, in both the Seven and Eight feet seams, with results equally satisfactory. The mode of using the machine in the working of coal would be to provide each set of colliers with a pair of steel tension straps, and the machine could easily be carried about by a man like a double-barrelled gun under his arm from place to place. It would thus be necessary to have only one press for a large number of these places; the entire cost of the machinery is very small.

The whole of the operations were conducted by the inventor, who states that the machine performs as much work as gunpowder; and as Mr. Higson had been instructed to report the result to the Home Secretary, some authoritative statement as to the efficiency of the machine may be looked forward to. It is well known to every practical man to be impossible, in every case, to provide a perfect system of ventilation, so that the gases, under all circumstances, may be rendered innocuous; it has, therefore, been found necessary to supplement the most approved system of ventilation by certain stringent rules with respect to the use of lights. The difficulty which has, however, always presented itself has been the use of gunpowder in blasting. It is clearly impossible to dispense with this system of working mines until some substitute has been discovered, and hitherto every effort in this direction has failed. The Legislature has, over and over again, been impressed with the necessity of prohibiting blasting in dangerous seams, but until something equivalent has been offered, it has been felt that great injustice would be thereby done to those who have the responsibility of such mines, and attempts have been made to diminish the risk by the introduction of stringent regulations. At length, after repeated efforts, the obstacle would appear to have been surmounted, and it is probable that, in a short time, the use of powder in dangerous seams at least will be prohibited.

NEW INSTITUE OF MINING, CIVIL, AND MECHANICAL ENGINEERS.

We have already stated that a society had been started in Wolverhampton, with the object of enabling its members, comprising mining, civil, and mechanical engineers, and other persons connected with or interested in mining, to meet together at fixed periods, and to discuss the means for the ventilation of coal and other mines, the winning and working of collieries and mines, the prevention of accidents, and the advancement of the sciences of mining and engineering generally. The name given to the society is "The South Midland Institute of Mining, Civil, and Mechanical Engineers," and its first President is Prof. BECKETT, F.G.S., M.V.I., M.I.M.E., the vice-presidents being Messrs. Silas Bowkley, F.G.S., Bradley; Thos. Rose, Bradley; and Edward Jones, Wellington. It has also a council, composed of twelve persons; Mr. James Cope is the hon. sec., and Mr. A. Morgan, C.E., the treasurer. According to the rules, the members of the institute are to consist of three classes—ordinary, life, and honorary members. The ordinary and life members are to consist of persons practising as mining, civil, or mechanical engineers, and other persons connected with or interested in mining and engineering, and the honorary members are to be mining inspectors during the term of their office, and other persons who have distinguished themselves by their literary or scientific attainments, or who have made important communications to the society. The ordinary meetings are to be held monthly, at the School of Art, Wolverhampton.

The inaugural meeting was held on Monday, at the School of Art, when there were present Prof. Beckett, in the chair; Mr. J. P. Baker, Her Majesty's Inspector of Mines for this district; Mr. T. Wynne, Her Majesty's Inspector of Mines for North Staffordshire and Shropshire; Mr. Edward Jones, Messrs. Silas Bowkley; T. Walker, solicitor; T. Holcroft, S. Bowkley, jun.; S. Fenn, of Pool Hays Colliery; D. W. Lees, Willenhall; Anthony Morgan, C.E., Wolverhampton Borough Surveyor; James Cope; Henry Griffiths, Chillington Company; H. Hill Beckett, W. Grove, sen., Joseph W. B. Green, Charles Simons, Thomas Hawkins, John Foster, Walton Ness, James Hodgkiss, Stephen Watkins, and others. Letters of apology for non-attendance, but expressive of sympathy, were read from Mr. Jacob Higson, Manchester; Mr. Thomas Rose, Wolverhampton; Mr. W. A Gilderoy, Holywell; Mr. Glennie, Wrexham; Mr. John Westwood, Derby; Mr. H. J. Marten, of Parkfield House, who anticipated that the period of united action between this and the Dudley Institute, though not, perhaps, immediate, could not be far distant; from Mr. James Nancarrow, recently of Shrewsbury, but now of Liverpool; and from Capt. Myles Sandys, now of Jersey.

The PRESIDENT then read his address, which was of considerable length. He said that the society would have among its other objects the encouraging of mutual respect and sympathy between masters and men. Towards the Dudley society he hoped that they should ever entertain friendly feeling, and that so soon as they gave up what he termed their organised opposition to the Government Mines Inspectors, there would be a union between them. A reference library he trusted would soon be possessed by the Institute, and he earnestly desired the carrying on of a correspondence between this Institute and the mining engineers of the United States, and other foreign countries. He referred to certain colliery mismanagements in one part of North Wales, and urged the members to guard against such thoughtless misdoings. Likewise, he would have them guard against the careless mode in which underground surveys were conducted, especially in the overlooking the constant changes of the magnetic meridian—a carelessness which often led to encroachments and innumerable difficulties. The study of geology was pressed upon the members, and instances given in which benefits accrued from mining sinkings suggested by an engineer who was a good geologist, whilst he mentioned what would have been a mining misfortune if certain recommendations made by other persons had been adopted. Scientific excursions and underground explorations, he trusted, would be undertaken and conducted with thoroughness, somewhat after the fashion of the members of the Government Geological Survey. One system of geological nomenclature was represented as most desirable, and the President, who is a member of the Victoria Institute and Philosophical Society for Defending Sacred Truth against "Science, falsely so called," contested some of the views expressed by Prof. Huxley, for instance. He believed that the present paucity of best pot-house clay was due to an absence of ability to detect the value of such clays. Silicates for glass making he believed existed around us, which would make it unnecessary for us to go to France for it. What was now taking place in the Buckley Mountains, in North Wales, might be seen in operation in this district, if only the value of the clays which were met with were known, in respect of their worth for brick and tile and pipe making. The worth of the different kinds of coal met with for the different uses to which our fuel-fossil was now put was enlarged upon as necessary to be ascertained. The character of the water which came into colliery workings must be set down, because of the clue which might be got from the record as to the character of the soil from which they came. As to accidents underground, he quoted with approval the views of Mr. Peter Higson, which were to the effect that the Government Inspector of Mines was convinced that the great bulk of accidents were unquestionably attributable to the large use of intoxicating drinks and tobacco by the miners. Both drink and tobacco should in Staffordshire, as in the best mining districts, be banished alike from beneath ground and from the banks on the surface. Great importance was attached to the correct recording of the positions in which the different qualities of ironstone were found, and even a very thin seam of coal should not be recorded with carelessness, even though it might at first seem to be useless, for such coal might be found useful for brickmaking or some other such use. Then there should be careful analyses of all ironstone found, and the analyses should be conducted upon the average of the samples, and not upon selected choice samples. Because selected samples had, he imagined, been sent to Dr. Percy of certain stone found upon the Duke of Marlborough's estate near Oxford, the noble owner thought his estate was of much more value on account of its minerals than so far as the explorations had gone was the case. An analysis of average samples, which he had himself conducted for the Duke of Marlborough, showed this. At the same time he believed that further explorations would result in showing a much more satisfactory state of things. He believed that the ore on his Grace's estate would prove equivalent to the Cleveland ore in the Middlesborough district, which had the advantage of an intermixture of carbonate of lime. That was far preferable to silica, which unfortunately abounded in their Northamptonshire ore to its prejudice. When igneous rocks occurred in coal fields, as marvellously developed in South Staffordshire and Shropshire, their singularly intrusive nature and ever-varying characteristics were especially deserving of study, as well as their atmospheric action on the coals and associated strata. In few other districts in the earth, perhaps, were these troublesome rocks more interesting to men of science, though sadly deteriorating in their effects, and fearfully expensive to sink through and otherwise traverse. Frequent outbreaks were found throughout the coal fields, but none more remarkable than that explored and approaching expansion at Park Hill, on the Earl of Lichfield's estate, at Bentley, near Walsall, which, until recently, was deserving of the most careful investigation, not only from its singular vertical as well as radiating columnar structure, but as associated with a tremendous east and west cross fault which defined a most important change in the mineral constituency of our local coal field. Great perplexity existed as to the period of igneous intrusion, and whether one or more centres of eruption may have existed in the South Staffordshire coal field; as also whether or not such disturbance was contemporaneous with like intrusive action in the Shropshire, Forest of Wyre, and Warwickshire coal fields. These difficulties would probably be removed if the members obtained accurate data connected with those localities, showing the relative position of undoubted central upheavings, the line base of the elongated horizontal expansions, and the accordance of their upward ramifications, combined with the reciprocal peculiarities of the component rocks, and the basaltic dykes occasionally met with, should be narrowly watched. He must tell them candidly that he did not anticipate that any direct and unceasing igneous connection would be discovered between the four coal fields alluded to, although the upheavings may have been and probably were simultaneous. He believed that the outer faults in each district would limit the extent of the igneous action connected therewith—a fact observable near Essington, from which he induced the director of the Government Geological Survey to publish a new edition of that portion of the South Staffordshire coal field, embracing also an analogous change on the opposite side of the same coal field originally coloured as Permian. Then there was a certain class of natural faults, which, with their occasional ramifications, and too often clandestine associates, deserved above all things to be minutely and accurately studied. After some excellent remarks upon the working and ventilating of pits in which faults occurred, the President concluded his address, which occupied about one hour and a quarter in the reading.

He was thanked for it, on the motion of the Government Inspector for South Staffordshire, seconded by Mr. Holcroft; and on the motion of Mr. E. Jones, of Granville Lodge, he was desired to print it.

The Secretary announced that the members already numbered 48.

The members then dined together at the Star and Garter Hotel, the Government Inspector for the district in the chair, when the usual loyal and other toasts were given, and responded to in a very satisfactory manner.

We have been requested to publish the following letter, which has been addressed to the Birmingham Daily Post:—

SIR,—In your paper of Tuesday you give a report of the inaugural address of the South Midland Institute of Mining, Civil, and Mechanical Engineers, delivered at Wolverhampton by Mr. Henry Beckett, the President of the New Institute. Seeing that a portion of that address contains a gross misrepresentation and an unwarrantable reflection upon a very useful and important institution, of which I have the honour to be a member, I cannot permit such a statement to go uncontradicted. Mr. Beckett is reported to have said:—

"He understood that a short time ago a society of local mine agents was concentrated in the little town of Dudley, and was said to be still in existence, but he regretted to say that though the fraternity alluded to professed to aid the advance of local practical colliery operations, it was understood to have originated partly from a condemnatory and thoughtless disposition to frustrate the well-known active efforts of the local Government Mining Inspector in carrying out his responsible and important duties. That had, he was told, prevented many thoughtful persons from joining the Dudley Society."

The "society of local mine agents" he refers to is the South Staffordshire and East Worcestershire Institute of Mining Engineers, comprising, as it does, nearly every mine agent of any repute from every part of the South Staffordshire district, and now numbers nearly 150 members. As regards his sneering remarks about the "little town of Dudley," and his belief that the Institute is "still in existence," I leave them to tell their own tales. Not so, however, with his remarks as to the Institute being organised to oppose the local Government Inspector. I repeat it, that this is a gross misrepresentation, and is made purposely by Mr. Beckett, for the purpose of damaging the Institute, and sowing discord.

But even suppose this was the case, then I contend Mr. Beckett is the last man in the world who should raise his voice. May I ask, has he forgotten the letter he wrote me three days after the local Government Inspector received the appointment, wherein he expressed his intense surprise, and added he should think it "was the worst appointment the Government had ever made," and that "so soon as the other Inspectors heard of it (he should think) they would one and all resign." Does he recollect this? If he does, I should be glad to learn why his altered tone in 1869. So far from the members of the Institute offering opposition to the local Inspector, he has been invited to attend their meetings and discussions.

There is another portion of the inaugural address I should be glad to notice, as it is a reflection upon my professional character as a mining engineer, and is an attempt to do me an injury. In speaking of the probability of coal being found in the unexplored country between South Staffordshire and Shropshire, he says: "A curious circumstances in connection with this subject may be noticed as evidencing a lack of mature thought. A rather inexperienced geologist, although a useful individual connected with the Dudley Mine Agents' Association," &c.; and then goes on to refer to my having suggested the new trial sinking near Albrighton, that being, as he thinks, the deepest place. I still contend that, to satisfy all the contributors, the trial should be as central as possible, notwithstanding that may be the deepest point, always remembering that the greater includes the lesser.

As regards my being an "inexperienced geologist," although I do not boast of an "F.G.S." or an "M.V.I.," I possess sufficient geological experience to know that "alumina" is not "derived from the decomposition of organic masses," as Mr. Beckett once wished to make his audience believe. When one professional man descends to lecturing another in a public newspaper, he should at least be up to the mark himself, and not place himself in such a position, by his previous writings, as for the Quarterly Journal of Science to say—"We must take exception to Mr. Beckett's chemical geology, especially with regard to his views on the nature, source, and distribution of alumina." (No. 7, July, 1865, p. 526.) Or even for the Geological Magazine to say of him—"We, however, deprecate very strongly the use of 'slang' expressions by gentlemen when lecturing on geology, and especially when there is an equally liberal number of quotations from Scripture, neither of which are needed," to introduce Mr. Henry Beckett's paper "On the South Staffordshire Coal Field." (Aug. 1, 1865, p. 338.)

I trust in Mr. Beckett's next inaugural address he will be more scientific, and less personal.—*Trindle-road, June* 9, 1869. HENRY JOHNSON.

THE CHEMICAL CHANGES OF CARBON.

Although the title is probably somewhat less attractive than it might have been, a more interesting course of lectures than those delivered by Prof. ODLING, F.R.S., at the Royal Institution during the last Christmas holidays, on the Chemical Changes of Carbon, it would be difficult to find, so that the handsome little volume,* containing a reprint of the reports of the lectures from the Chemical News, with Mr. Crookes's notes upon them, will be sure to meet a favourable reception. The lectures having been designed expressly for a juvenile auditory, are precisely calculated to suit the tastes of those who desire a faithful outline of the subject without the minute details regarding principles which to those intending to study professionally would be indispensable. In his excellent little preface Mr. Crookes very truly remarks that few men who have ever devoted themselves to chemistry forget their first attendance at a chemical lecture. The lecturer, as he says, may not be profoundly learned, or even a brilliant manipulator—he may use hard words, and omit to explain them; he may totally fail in some experiments, and only partially succeed in others—it matters not; to an intelligent and imaginative boy there is a magical charm about the new world thus opened to his mind which time can never efface. And if these remarks are true with regard to a lecture heard under certainly not the most advantageous circumstances, how much greater must be their force when one's introduction to the mysteries and beauties of the science are obtained through the medium of such entertaining lectures as those of Prof. Odling, on the Chemical Changes of Carbon—a title which really embraces the entire division of chemistry most closely connected with domestic life; the chemistry of all that contributes to our health, our comfort, and our enjoyment.

To attempt to furnish anything like a complete account of the contents of the volume would be out of the question, owing to the enormous amount of information which has been compressed into a very limited space. Taking an ordinary piece of charcoal, Prof. Odling sought to convey an idea of the almost innumerable changes which charcoal or carbon undergoes according to the nature and proportion of other things with which it is combined to form the various substances around us, such as marble, coal, loaf sugar, peat, and so forth; performing the task he had undertaken in a manner which could not fail to impress the facts he had to bring forward indelibly upon the minds of his youthful hearers. In his first lecture he treats of marble, lime, and carbonic gas, and he then proceeds to explain the production of this gas by the combustion in air of charcoal, coal, wood, candle, or gas. Next he treats of common air, and of various substances the successful manufacture of which depends upon the careful application of ascertained chemical principles; until by the time the end of the sixth lecture is reached much sound and useful knowledge will have been acquired, and, it will be admitted, in a very agreeable manner. The fifth lecture, on graphite, diamond, and solid carbonic acid, is a particularly interesting one, and the same may be said of the concluding one, in which the nature and properties of the bisulphide of carbon are carefully explained. The value of the lectures is much enhanced by Mr. Crookes's annotations, which will be found especially valuable to those readers who have not the advantage of oral instruction.

To the beginner in chemical studies Prof. Odling's lectures are well calculated to excite a love of the science, and to those who have already learned something of the wonders of chemistry the perusal of the volume will give much pleasure, and probably add materially to their fund of knowledge.

* "A Course of Six Lectures on the Chemical Changes of Carbon." By WILLIAM ODLING, M.B., F.R.S., &c. Annotated by WILLIAM CROOKES, F.R.S. London: Longmans, Green, and Co., Paternoster-row.

THE GOLD AND SILVER REGIONS OF THE WORLD.

Although the industrial classes of all countries which were represented at the recent international gathering at Paris derived, no doubt, more or less advantage from the facilities which it afforded for obtaining a knowledge of the progress being made by the various nations of the world, the amount of benefit secured has been anything but equal, and England has, probably, been the country which has least profited, owing to the majority of those who have publicly referred to the Exhibition having contented themselves with deploring the supposed approaching industrial decay of Great Britain, instead of pointing out the precise details of foreign merit, or describing what they saw which, in their opinion, was worthy of adoption at home with a view to the promotion of the industrial welfare of the country. Concise and useful records of the last Paris Exhibition can only be obtained from French and German sources, whilst for the best reports in the English language we must go to the United States; though even there the delay which has taken place in their issue has deprived them of much of their value, except in those instances where it has been practicable to continue the information so as to adapt it to the present time. This course has been adopted by Mr. W. P. BLAKE, the Commissioner for the State of California, to the Paris Exhibition, in his volume* referring to the yield of the principal gold and silver districts of the world. The author remarks that the short time allowed for the work (from September to December, 1867) did not permit of an attempt to describe and discuss the various methods of extracting the precious metals from their ores, and as most of the principal gold and silver producing regions of the globe were represented at the Exposition by specimens, maps, and statistics, with the object of presenting a view of the nature and the extent of the resources of each country in the precious metals, it appeared proper that the report should compass, as far as possible, the object of the various exhibits. But Mr. Blake also included notices of regions not represented at the Exhibition, in order to give as nearly as possible the statistics of the annual production of gold and silver.

Originally the statistical portion of the report extended in most instances to the end of 1867, but the delay in printing has enabled Mr. Blake to take the opportunity of adding information and statistics, especially from South America, Russia, and Europe, obtained to the end of 1868, and even later. There has been a considerable falling off in the production of the precious metals on the Pacific Coast, not only in gold, but in the silver of Nevada, but this adverse comparison Mr. Blake seems to attribute rather to the figures for 1867 having been too high than to a real decrease to the full extent shown. He thinks the total yield was probably about 14,000,000*l.* for 1867, and about 13,000,000*l.* for 1868. The mode in which the subject is treated affords great facility for obtaining from the report any information that may be required—the metals are referred to separately; first gold; then silver; and, lastly, platinum and other metals; and employing the particulars contained in these chapters for, as it were, a basis, he proceeds to the consideration of the aggregate production of the precious metals; their consumption and movement; and the unification of gold and silver coinage. By way of appendices there are given some valuable tabulated and other particulars relating to the production of the precious metals in several countries since the date of the report; relative values of gold and silver; rules for the calculation of alloys and values; deposits, coinage, exportation, and production of the precious metals; and metrical and other weights, and their equivalents.

The work, as a whole, is a valuable addition to our mining literature—the accounts given of the Gold regions of North America (which is accompanied by statistics of the production of the metal), and of the Silver regions of the United States, will prove especially valuable from the facilities which the author possessed for obtaining reliable information; and as the office held by Mr. Blake in connection with the Paris Exhibition enabled him to procure the facts relating to the Gold regions of South and Central America, Australia, New Zealand, Europe, Asia, and Africa from the best official sources, the utmost confidence may be placed in them, so that no doubt need exist with regard to the

* "The Production of the Precious Metals: or Statistical Notices of the Principal Gold and Silver Producing Regions of the World." By WILLIAM P. BLAKE. New York: Putnam and Son. London: Trübner and Co., Paternoster-row.

accuracy of any comparison that may be made upon the authority of the book. As to the style of printing, it will be unnecessary to say more than that the main portion is printed from the American Government plates, and that the additions and appendices are equal to any other part of the volume. The work will be read with interest and profit by all classes of the commercial community.

CYCLOPÆDIC SCIENCE SIMPLIFIED.

The opinion is by far too generally entertained that during the earlier period of studying the natural sciences a large amount of mental drudgery has to be gone through before the point is reached at which the task becomes a pleasure, from the student acquiring the power of seeing a scientific interest in almost everything that comes before him. Yet it is not so much the study as the mode of studying that is the really repulsive part of the matter, and when, as in the case of Prof. PEPPER'S volume,* now under consideration, a large and elegantly bound volume, with pictures on almost every page, showing popular philosophical apparatus in so striking a manner that the object and construction of each instrument can be readily understood, but little more is required to secure the least tractable pupil. To discover novelty in a work of the nature of "Cyclopædic Science Simplified" would, in truth, be to discover a very great defect, the relative merits of such works depending not more upon the number of facts given than upon the mode in which those facts are set forth. Prof. Pepper is unquestionably one of our most popular scientific lecturers, and it is to his great ability that many owe their acquisition of a love for the rational and harmless amusements offered at the Royal Polytechnic, rather than for the almost innumerable attractions of a less refined character, such as music halls and casinos, abounding in London, and with which that useful institution has to compete.

To those who have been in the habit of visiting the Royal Polytechnic it would be unnecessary to say more in commendation of the book than that it contains what might be considered an enlarged and revised report of Prof. Pepper's lectures, with ample descriptions of the apparatus by which the experiments rendering those lectures so enjoyable and instructive are produced. The volume embraces a complete elementary course of the sciences of Light, Heat, Electricity, Magnetism, Pneumatics, Acoustics, and Chemistry, not in the dry systematic style employed by those whose object is to teach men who have to turn their knowledge of the sciences to commercial advantage, but popular readable way, which will secure it the favour of all classes of the public, which, as Prof. Pepper remarks, has not the time nor the inclination to study the very minute and laborious works of learned authors who make a single science their special study. He expresses the hope that the work may be found sufficient to stimulate, at all events, the would-be philosopher to further reading, and especially to perform correct scientific experiments. That this hope will be fully realised he need have no misgivings. Prof. Pepper has embodied some of the finest thoughts of such men as Faraday, Brewster, Tyndall, Wheatstone, Noad, Daniel, Crookes, Browning, and Siemens, and put them together in a connected form, which cannot fail to prove attractive.

The work is profusely illustrated, containing some 600 engravings, and issued in a style which entitles it to a position amongst the most popular of gift books for youths, whilst it has the great recommendation that the information given is sound, speaking in a scientific sense, and of a nature which is sure to prove valuable to those acquiring it. A more suitable book for the library of an industrious and intelligent lad we have never seen.

* "Cyclopædic Science Simplified." By J. H. PEPPER, Professor of Chemistry, Royal Polytechnic Institution, F.C.S., &c. London: F. Warne and Co., Bedford-street, Covent-garden.

JOINT-STOCK COMPANIES' DIRECTORY.—It is essential that the trade library of the man of business should be as small and as utilitarian as possible, yet there are certain books which are quite as indispensable as those of account, and amongst these the Joint-Stock Companies' Directory (published by Messrs. CHARLES BARKER and SONS, of Birchin-lane, the well-known advertising agents) is unquestionably entitled to a place. The edition for 1869 gives quite as much evidence of extreme care in compilation and arrangement as either of its predecessors—all procurable information respecting joint-stock companies throughout the kingdom is given in a form alike systematic and complete, so that the work is equally valuable to all doing business with public companies, whether resident in town or country. The Directory has been corrected up to the latest moment, and as the names and particulars of all new companies, and companies which have recently gone into liquidation, are carefully given, it is difficult to suppose that anything more could be desired. The Appendix, always an important portion of the book, has been largely increased, the particulars of 22 new public loans brought out in 1868 having been added to the very extensive list. An office in which the Joint-Stock Companies' Directory does not occupy a place beside the Post Office London Directory cannot be considered completely furnished.

EXTRAVAGANT USE OF FUEL.—A valuable little treatise on the Extravagant Use of Fuel in Cooking Operations has just been issued (through Messrs. Longmans, of Paternoster-row) by Mr. FREDERICK EDWARDS, jun., whose treatises on Our Domestic Fireplaces and on the Ventilation of Dwelling Houses are already well and favourably known to the public. Mr. Edwards displays a very intimate acquaintance with the subject, and his account of the Count of Rumford and his economical systems are very valuable. The knowledge that, with all the disadvantages of dear coal and prejudice against innovation upon existing arrangements, Count Rumford succeeded in providing a good soup dinner for 1000 persons at a cost of less than 4½d. sterling for fuel, should suffice to induce philanthropists of the present day to exert themselves in the same direction. It is computed that the same soup could be provided in London at a cost of less than ¾d. each person; and there can be no doubt that if the London poor were furnished with only one such meal daily, and their children trained up in the knowledge of some handicraft and to habits of industry, a large additional amount of happiness would be secured. Mr. Edwards, in addition to informing us what was done, is careful to explain how it was accomplished, the numerous engravings of plans and sections of cooking arrangements with which he has embellished his book greatly facilitating his task of rendering everything clear and practically useful. The book will prove extremely useful to all who purpose improving their domestic arrangements with a view to economise fuel.

TABLES FOR WORKMEN'S WAGES.—It frequently happens that the more skilled the workman is at his own trade the less ready is he at the performance of calculations, so that after his work is done he has some difficulty in ascertaining its value. To remove this inconvenience, an elaborate set of Tables for Workmen's Wages, containing upwards of 7000 calculations for the use of mechanics, labourers, and others, by Mr. HENRY LAXTON, C.E., has just been issued by Messrs. Letts, Son, and Co., of the Royal Exchange. The sett comprises four tables—the first showing at per day how much per week, month, and year; the second, at per year how much per month, week, and day; and the third (by far the most useful one to the classes for which it is intended) showing the amount earned in any number of hours from 1 to 100, at any rate from ¼d. to 12¾d.; and the fourth showing of any number of days, quarters, and hours from one to ten at per day. Messrs. Letts have also published a little book of perforated gummed labels, which will be found useful for numerous business purposes.

UTILISING WASTE STEAM FROM CYLINDERS.—The invention of Mr. ROBERT MELDRUM, of Pittormie, Scotland, for the utilisation of the waste steam which has done its work in the cylinder without condensing it with cold water, consists of a chamber or chambers (which latter are connected with each other by proper openings) in which fans are mounted, and from which, as well as the boiler cylinder and parts in connection therewith, common air has been extracted, either through displacement or by an air-pump. The steam when allowed to bear on these fans, owing to their position, will drive them round at a very great speed, but in accordance with the power of the steam, and there being a sufficiency of the above, the steam will in its progress lose its power until it has none; or, in other words, be received into a vacuum. These chambers by their proper ducts will receive the condensed steam, from which, or other suitable place, it may be pumped back to the boiler, thus forming a continuous revolution of the motive power. The fans hereinbefore described should be made to fit closely at the top and sides of the chambers. The openings communicating between one chamber and another he prefers to make as one large orifice at the top for the steam, and a smaller one at the bottom for any water formed to pass through, and in the first chamber this bottom orifice should be very small, in order that as little steam as possible may pass through it. In succeeding chambers the holes may increase in size according to the size requisite for removing the water formed. There may be sets of chambers ranged in order side by side, or otherwise, which may be connected by tubing, according to requirement for condensation.

MANUFACTURE OF IRON, STEEL, &c., MAKING TOOLS AND OTHER ARTICLES.—The invention of Messrs. A. MUNRO, of Arbroath, and W. B. ADAMSON, of Glasgow, relates, in the first place, to the employment of creosote or hydrocarbons, for the purpose of making tools and other articles, composed of iron, steel, or metallic alloys, much harder and more thoroughly tempered than hitherto. The tools or other articles to be hardened or tempered are heated to the necessary temperature, and cooled by immersion in the creosote or hydrocarbon, and to further increase the hardness or temper of the tools or other articles carbon or other indurating substance may be mixed with it. This invention relates, in the second place, to the manufacture of iron, steel, and metallic alloys, or tools, or other articles composed of iron, steel, or metallic alloys, and it consists in treating the iron, steel, or metallic alloys in the following manner:—The iron, steel, or metallic alloys are melted and rendered dense and hard by being cast in chills, the chilled iron, steel, or metallic alloys is or are then re-melted, and re-cast into chills, the result being the production of a much harder, denser, and more durable material than hitherto obtained. For the purpose of rendering the metals so treated still harder and denser, they may be re-melted and cast into chills for any number of times. It is to be understood that tools or other articles manufactured under the second part of this invention may be treated by creosote or hydrocarbons, with or without indurating substances added thereto, as hereinbefore described.

GOLD EXPORT OF NEW ZEALAND.—Official returns show that the export of gold from New Zealand in the year 1868 amounted to 637,474 ozs., of the value of 2,504,326*l.*, being 49,279 ozs. less than in 1867. The total export from the colony up to the end of the year 1868 was 4,383,688 ozs., representing a sum of 17,014,899*l.* This, at the rate of 2s. 6d. duty per ounce, would yield to the colony a revenue of 547,961*l.*

LONDON GENERAL OMNIBUS COMPANY.—The traffic receipts for the week ending June 6 was 12,182*l.* 8s. 6d.

Meetings of Mining Companies.

LAGUNA SILVER MINING COMPANY.

An extraordinary general meeting of shareholders was held at the offices, King William-street, on Monday,

Mr. C. S. HILL in the chair.

Mr. GEORGE E. HOOKE (the secretary) read the notice convening the meeting.

The CHAIRMAN explained that the object of the present meeting was to confirm the special resolutions passed at the previous meeting for raising additional capital by preference shares. He then read the resolutions, as follows:—1. That the capital of the company be increased by the sum of 5000*l.*—2. That such increased capital be raised by means of preference shares.—3. That the Articles of Association of the company be altered by the omission of Article 27, and the substitution therefor of the following articles, with such variations or modifications (if any) as the company shall at such general meeting determine. (He then read the Articles 27a to 27h.)

Mr. B. C. HOOKE seconded the proposition.

Mr. H. SEWELL, being questioned by the Chairman, produced a letter from Mr. Newbold, manager of the London Bank of Mexico, in the City of Mexico, who arrived three weeks ago in this country, in which that gentleman stated that he believed, from personal observations, that the present state of Mexico had never been more favourable to mining, as the Government was dictating every possible measure for advancing mining interests. Mr. Sewell stated that the Government of Mexico where at present sacrificing a great part of the revenue from mining, in order to give every inducement to foreign capital being invested in the Republic. As to Laguna, he believed it was likely to turn out quite as good a mine as Rosario. One thing was quite certain, and that is if it were given up by the present company it would be gladly taken up by Mexicans in the neighbourhood.

Mr. SMITH thought it was of importance that shareholders should not be unmindful of the fact that it was admitted on all hands the property well deserved a further trial.

Mr. SEWELL said it was of vital importance that the mine should be worked economically, and by one practically acquainted with silver mining.

After some further discussion (during which the directors and shareholders present announced the proportion of the new capital each proposed to subscribe for), the motion confirming the special resolution was put and carried unanimously. A vote of thanks was passed to the Chairman and directors, when the proceedings terminated.

The *veta madre* or champion lode of the district of El Chico is undoubtedly entitled to rank amongst the most valuable of the Mexican mineral veins, and considerable interest is, therefore, felt by those engaged in foreign mining enterprise in every undertaking the object of which is further to develope its riches. At the present moment there is the celebrated Arevalo property, which has given such returns, even under native management, as to render its name famous throughout the Republic; and immediately to the east of, and adjoining, this is the property now being worked by the LAGUNA SILVER MINING COMPANY, whilst still further to the east are the Jesus, the San Rafael, and the Rosario Mines, not less celebrated than the Arevalo. The Laguna Mine has recently been reported upon by Mr. John P. Sewell, of the Real del Monte Mines; and, as the Laguna Mining Company are raising capital by preference shares (in order that they may be enabled to work their mine with the energy it deserves), the publication of his report will not be uninteresting. Writing from Real del Monte, on Nov. 5, Mr. Sewell states that during the previous month he had been at El Chico for four days, and examined thoroughly, not only the Laguna Mine, but several others, and also several plans of the district, in Mr. Rule's possession, all which tend to the formation of a decided opinion respecting Laguna. He continues—

You lay great stress upon the southern cross-cut. It was an experiment to prove the south part of the vein, the distance being naturally small, as it was across the vein, and, therefore, could not be long or expensive. As the Laguna vein is a wide one, varying from 10 to 20 varas in width, it is necessary at times to cross-cut it, as there may be metal close by you without your being aware of it, and when the indications are favourable it is the most natural proceeding to cross-cut the vein. The sinking of the shaft is done by contract, at $100 per vara. If anything, the price is low; probably if Englishmen instead of natives were employed a higher price would be demanded, and the work would advance more quickly. Since I have been to revisit Laguna, I am now in the position of confirming that in Mr. Rule you have a first-rate mining engineer, and one who will deal honestly with you, as I formerly stated. It is true he might be more at El Chico, but as the amount of work and progress is so slow there is not the same necessity as if you were carrying on several works, in which the ground, appearances, or metal varied. The shaft has to be sunk through certain ground, whether it has metal or not, because the shaft is sunk in order to effect the drainage and extract the stone, whether it has metal or not.

Referring to your letter of Sept. 1, about a communication between Laguna and Arevalo, on the one hand Mr. Rule cannot enter into Arevalo sett without having a regularly defined bunch of metal, extending from Laguna to Arevalo. The Ordenanza then allows the owners of the mine to enter an adjoining sett on giving due notice, and the ores and expenses are equally divided, whether the adjoining mine agrees or not. Without a regular defined run of ore, Mr. Rule cannot, therefore, enter Arevalo sett, and it is not likely Mr. Mancera would agree to Mr. Rule's searching for ore in his ground. If, on the other hand, Mr. Rule found a run of metal going from Laguna into Arevalo he would certainly work into the latter, and if it turned out an important discovery then Mr. Mancera would sink down to communicate, and as soon as he reached the point where the metal was being extracted Mr. Rule's right of working ceases. This is the mining law on the point. However, Mr. Rule has not found such a run of metal, and Mr. Mancera has not endeavoured to communicate. Close to the Laguna shaft, on the west side of the rivulet, and in his own ground, Mr. Mancera has an adit of some 10 varas. From this adit we supposed, when I last visited Laguna, that Mr. Mancera would sink down, in order to get into the same bunch of metal that you had. From what we hear, as we could not enter into Arevalo, Mr. Mancera is again working in this adit, and extracting some metal, but has not sunk to any depth, as the water will prevent his doing so, and he has not taken measures, by erecting a water-wheel, to enable himself to explore the mine in depth. It shows, however, that at a short distance from Laguna the vein contains metal, and from good authority I hear that Edwards, an Englishman who formerly worked in Arevalo, always incited Mancera to work towards Laguna, the principal workings of Arevalo being at St. Ysabel shaft, 400 varas west of Laguna, and the ground between them (Laguna and St. Ysabel shafts) is still virgin.

Mancera did not follow Edwards' suggestion, because he thought by exploring his eastern ground the quantity of water would be increased in St. Ysabel shaft, and as he cannot effect the proper drainage of the latter it would only increase his difficulties in that respect. Edwards stated that the levels east from St. Ysabel towards Laguna had a quantity of ore of average quality even then. Edwards afterwards was employed for several years as agent at Capula by Dr. Chester. The reason that the Arevalo sett has not been explored near Laguna is due to Mancera's want of means to secure an effective drainage, and also that he has concentrated all his energies in driving the great "Aurora" adit, which is now distant from St. Ysabel shaft some 130 varas, and will effect the desired drainage: when it is completed, no doubt one of the first works of Mancera would be to explore his sett in the direction of Laguna. I mention these details because from your letter you appear to have some doubts as to the value of the ground west of Laguna. It affects Laguna if the Arevalo sett were proved to be poor in the direction of the former.

The completion of the "Aurora" adit will be of some advantage also to Laguna, as at present the latter, by its shaft, drains to some extent the Arevalo ground near it; later on, the reverse will take place, and it is important as Laguna goes deeper that it should only drain its own ground, although Laguna shaft, from its low position, can have another water-wheel when required by abundance of metals or increase of water inside the mine. The St. Ysabel shaft is on high ground, and cannot obtain increased water-power, or it would have had it long since.

The Mexicans have a dislike to engines, because they cannot manage them, and prefer an adit, however long or costly. Everybody knows, however, the ultimate value of Arevalo, and that when properly worked it will again give a great "bonanza." When one person of good judgment, and in a position to obtain accurate information, gives $16,000 for a mine on the same vein as yours, you have little right to complain when you have only got $20,000 to the debit of your mine. You progress slowly, but that is owing to the small amount of capital you invest, and you will never get into the difficulties that embarrass Mancera, because Englishmen know how to work mines.

The meeting with metal depends on the place where you set to work, and the number of trials you make, a greater amount of capital enabling the manager to have several works of investigation. A manager may be found fault with if the works are not well carried on, for bad ventilation, and for the amount of work not corresponding with the outlay, but he can scarcely be found fault with for not discovering metal, especially if only one work of exploration is carried on, and that at the rate of only half a vara a week. The nature of the ground determined the position of the Laguna shaft, and not the appearance of the vein or metal. It was the right place to set the shaft, at the bottom and not the top of the hill over which the vein passes. You found ores in the very place you sank the shaft, and this proves that the vein is abundant in metal. It is by means of levels that veins are generally proved, as the shafts are in most cases outside the vein, and generally perpendicular, and constructed for the extraction of the stone, metal, and drainage. It is wiser when the ground permits to carry out these objects as well as exploring the vein at the same time, and the credit is due, therefore, to Mr. Rule for effecting all these by the same means.

Some of the Real del Monte mines have over $300,000 to their debit, many have half that sum, and $50,000 may be considered as the lowest figure at which our company prove a mine before getting dividends from it. However, in our district we seldom meet with any abundance of ores till 200 varas depth. The district of El Chico has given metal much nearer the surface, as is proved at Arevalo, El Torno, San Rafael, and the Laguna, but in general the ground is harder in the veins at El Chico, and this causes delay and expense in the works. The average depth of our mines is 400 varas; some reach 551 varas perpendicular, so you may imagine the expense of drainage and the extraction of the stones from that depth, and that you have no reason to be disheartened.

In mining the greatest caution and judgment are required—in the first instance, in the choice of a mine, and also of a manager, but when the first especially has been made, even if returns are not forthcoming so soon or so regularly as desirable, it is not a sufficient motive for abandoning, or not working actively, and in the case of the Laguna, renewed activity is required. It must be taken into consideration that mining gives 100 for 1 invested, and often more. Silver mines have to be carried on generally for two or three years without any returns being made. My father worked the St. Jose Mine, near Copiapo, Chilé, for many years without getting returns, but in 1851, when I was living at the mine, it gave in that year $209,000 clear profit, and for several years after continued to give a handsome profit. Although Mr. Rule said, when your first letter arrived, that there was not much change in Laguna since March 1866, and that it was not worth while to make a special journey to see it, I determined on going to El Chico, to revisit your property, and therefore went down to the bottom of the shaft. You are nearly 90 varas depth, and the appearance of the vein in the last few varas has improved considerably. The vein has a quantity of calcarous spar, which is one of the best indications in it of the approach to an improved strata or metalliferous ground, and besides, there are "pintas," or spots of metal, all round the bottom of the shaft. A stone which I brought away assays 15 mares 2 ozs. per monton, as per enclosed certificate of assay of Don Felipo Parrez, a mining engineer and assayer in the Real del Monte Company. This is clearly a progressive improvement, and there is every hope it will increase. The trial of Laguna should not, however, be limited to sinking the shaft. Half a vara weekly is slow progress, although more cannot be done, according to Mr. Rule. I should, however, have Englishmen for the sinking of the shaft, although it would be more expensive as regards the price per vara, but more would be done in a shorter time, and the difference is fully compensated for. The natives might be employed in driving a level to the east or elsewhere to explore the vein. I proposed to Mr. Rule to commence the level east, as was also done in March, 1866. Perhaps Mr. Rule may be more disposed to carry out this, now that the vein presents a more favourable appearance. There is a small adit on a vein called the Purisima, situated a little way down the ravine. It has been driven over 50 varas. Some of the workmen showed where there was some metal which they were extracting near the entrance. Further in the adit the ground has been worked away, and $10,000 worth of metal extracted. I decidedly think that it is most important that this adit level, on a vein more than a vara wide, should be continued, as the ground is not hard for driving until it reaches the Laguna vein, where there is every probability of a good bunch of ore being found at the junction of the two metalliferous veins. The direction of the adit on the Purisima vein is almost at a right angle to the Laguna, and consequently the shortest distance or road to it for proving the Laguna at about 110 varas east of the present workings. As the hill towards the east rises a great deal, the adit would cut the Laguna vein at a depth of 100 varas.

The desired object of proving Laguna to the east would be effected more quickly and cheaply by this means than by driving the level east from the shaft, where the ground is much harder than in the adit, and, besides, all the stone which is blasted can be taken out easily in wheelbarrows. Still, as the ground appears favourable, the level east might be driven from the shaft to prove if the favourable indications improve, and if not it might be stopped. If you are not inclined to try both, commence with the Purisima adit, and leave the level east till the 100 varas have been reached in the shaft. In this way the expense would not be much increased, and you would be working at a cheaper rate per vara than you now are, as you will see by comparison later on, especially if you compare the cost of the vara then with that of the past two years. The real progress must be computed by the number of varas driven, and the economy of working by the cost of these varas in comparison with the former cost of them. I was not aware on my former visit of the existence of the Purisima vein and adit, and as I went without a specified authority, I did not see the plans of the mine and district, and the time employed was too limited for an examination of the ground surrounding Laguna, and the captains who were sent purposely do not appear to have spoken on the subject, and I do not think they thought of examining the ground. In driving the Purisima adit some metal may be found, as I have made all the enquiries I could, and Mr. Rule will no doubt give you further particulars, as I have called his attention to the importance of the work. The adit will serve to drain Laguna to some extent, and will withdraw some of the water that now finds its way to the shaft. The junction of the Purisima vein and the Laguna is one of the most likely and favourable for finding a "bonanza." Mr. Rule tells me that the adit will cut a vein parallel to the Laguna vein before it reaches the latter, and he has great hopes of finding metal there at that junction of veins. My attention was directed to this adit because we went into another adit, the "San Marcos," close by, driven to prove the "Jesus" and "San Rafael" Mines, which form the adjoining property, east of Laguna. I was desirous of proving the value of Laguna, comparatively, on the east, as I have shown by "Arevalo" on the west. As Mr. Rule will forward a plan of the ground, it will elucidate my report more clearly than I can do simply by writing, and there is no necessity for a rough sketch, which I should otherwise have been obliged to send you.

We called on Mr. Paredes, who is well informed about "Jesus" and "San Rafael." Mr. Paredes informed us that the owners of "Jesus" and "San Rafael" got a "bonanza" which repaid them for the cost of the "Torno" adit, now belonging to the El Chico Company, and that he had occasion to visit the property, when he saw 15 varas width of metal in the vein under the San Rafael shaft. He said that the ores kept three haciendas in full work. In consequence of the levels being worked out so wide for metal without proper supports the ground fell in. Mr. Mancera then attempted to communicate to these workings from another shaft, called the Tiro Nuevo, by working on the jabones, or soft clay, on one side of the vein. Mr. Rule who had some interest there went to inspect, but the mason work was so bad that it began to give way while he was there, and he had to crawl through. Soon after the arches gave way, and the works in this quarter were given up, and the San Marcus adit was commenced; 350 varas have been driven, and 200 more are required to reach "Jesus" shaft. We saw several montones of ore, which were extracted near "Jesus" shaft, identical to some now at Laguna, which are being taken out by the veladores of the mine. At the point visited by Mr. Rule, they were already commencing to extract metal through the Tiro Nuevo. It is not strange that these accidents should happen to Mr. Mancera, or any other Mexican, but as they know the value of the property they will not give it up, any more than Arevalo. I requested Mr. Rule to obtain a written statement of all he knew about "Jesus" and "San Rafael," from Mr. Paredes, as this gentleman speaks, not from hearsay, but from what he himself saw and knows to be true.

With all the foregoing statements, I think you will be as fully convinced as I am of the great value of the Laguna property.

Mr. Sewell concludes by observing that it rests with the company to order some of the trials which he has suggested to be carried out, and to provide the funds, and he feels pretty certain now that Mr. Rule sees the necessity of renewed activity, and concurs in his opinion respecting the points which should be worked, especially the Purisima adit; and in this respect his task has been easier than he expected, as they have not differed, and that he facilitated in every way the object he had in view of obtaining all the information necessary to forming a decided opinion of the prospects and value of the Laguna Mine, which he trusts he has clearly explained to you. He expresses the hope that the company are prepared to carry out his advice, and to provide the requisite funds—say, 5000*l.* more to work the mine.

TAQUARIL GOLD MINING COMPANY.

The second ordinary general meeting of shareholders will be held on Wednesday. The report of the directors, to be then read, states that they deem it expedient to enter into some few particulars relative to the past as well as to the present position of the company. The report presented at the first ordinary general meeting of the company, held on Aug. 5, 1868, stated that Dr. Birt having offered to go out to Brazil to take possession of the property, had left by the steamer of July 9. Under date Aug. 26, 1868, Dr. Birt advised the board that he had been put into possession of the property in accordance with all the formalities of the Brazilian law, and the company's agents, Messrs. John Moore and Co., are now investigating the titles. The directors have the satisfaction of reporting that Capt. Thomas Treloar has undertaken the post of consulting engineer to the company; and by the last mail Capt. Treloar advised that he had taken measures for the proper management of the establishment, and that he hoped to visit the mines on May 9 or 10, and report thereon. As soon as the board has been furnished with his report, a copy will be immediately forwarded to the proprietors. Under Capt. Treloar's management the works will be energetically prosecuted, and the shareholders will be kept regularly informed, by means of the monthly slips, of the progress from time to time made.

Captain H. Pengilly (who returned from Brazil by the last Southampton steamer) states that since the last report the deep adit has been driven and timbered 18 fms., and should the ground continue as at present 30 fms. per month will be executed until reaching the extent of about 80 fms., when the adit will be driven on the course of the lode, in order to cut more shoots of gold, which he thinks will be met with before reaching the old workings or gold shoots already discovered. He cannot exactly say the depth of the old engine-shaft, but was informed by the former proprietors, in 1837 and 1838, that it was 40 fms.; this being the case, the bottoms of the old workings will be reached in about thirty days after the pumping-engine is set to work, which they calculate will take place about the middle of August, or before if possible, as the surface works are now going on with great rapidity. There are 15 fathoms between the new engine-shaft and the old one, which can easily be communicated with in a few days, when, no doubt, satisfactory quantities of gold will be taken out. He cannot conclude his report without offering his opinion (coinciding with most of the practical miners there) that the Taquaril Mine is in higher estimation than the successful Don Pedro, &c. The result, he has no doubt, will justify. As soon as the mine is unwatered and the cross-cut driven on the shoots of gold it will prove to be as good a mine as any in Brazil.

[For remainder of Meetings see to-day's Journal.]

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